UNIVERSITY OF NATAL

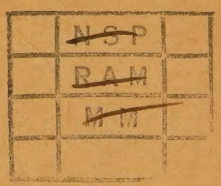
PIETERMARITZBURG
SOUTH AFRICA

WATTLE RESEARCH INSTITUTE

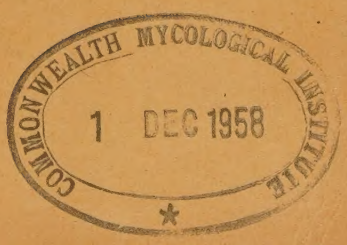
South African Wattle Growers' Union — University of Natal —
Union Department of Forestry

REPORT FOR 1957–1958

(ELEVENTH YEAR)



OCTOBER, 1958



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OCTOBER, 1958

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COMMITTEE OF CONTROL OF THE INSTITUTE

Appointed by the South African Wattle Growers' Union (3):

S. Clegg, Esq. (*Chairman*).
Major C. J. J. Crowe.
R. B. Fyfe, Esq. (*Resigned October*, 1957).
S. J. F. Nuss, Esq. (*Appointed November*, 1957).

Appointed by the University of Natal (2):

Professor A. J. W. Bayer, D.Sc. (*Vice-Chairman*).
Principal E. G. Malherbe, M.A., Ph.D., LL.D.
Alternate: H. H. Cornell, Esq., B.A.

Appointed by the Union Government Department of Forestry (1):

C. E. Lack, Esq., B.Sc. (*Resigned January*, 1958).
M. van N. Möhr, Esq., B.Sc. (*Appointed February*, 1958).

The Director:

Professor H. Shaw, M.Sc.Tech., Ph.D., F.R.I.C.

Honorary Secretary:

P. G. Leeb-du Toit, Esq., B.Com. (*Registrar, University of Natal*).

STAFF

(SEPTEMBER, 1958)

DIRECTOR:

H. Shaw, M.Sc.Tech, Ph.D.(Manc.), F.R.I.C.

Silviculture:

S. P. Sherry, M.A.(Oxon.), B.Sc.(South Africa).
K. Roberts, B.Sc.(Wales).

Technical Assistants:

M. J. Lourens.
A. M. MacKenzie.
I. S. Alexander.

Genetics and Plant Breeding:

A. A. Moffett, B.Sc.(Birm.), Ph.D.(Lond.).
Miss K. M. Nixon, M.Sc.(Natal).

Technical Assistant:

B. L. Arbuthnot.

Chemistry:

W. S. Martin, Ph.D., D.Sc.(Lond.), A.R.C.S., D.I.C., A.R.I.C.
C. G. Gordon-Gray, M.Sc.(Natal).

Technical Assistant:

R. A. Jones.

Entomology:

L. L. J. Ossowski, M.F., For.Ing., D.Sc.(Poznan).

Technical Assistants:

G. B. Wortmann.
J. A. Hunt (*Resigned September*, 1958).

Biometry:

E. R. Vaughan, B.Sc.Hons.(Natal).

Administration:

Miss E. K. Smith.

Non-Europeans:

Eight.

Field Experiment Station Overseer (S.A.W.G.U.):

M. A. Stewart.

FOREWORD

The year just completed will be remembered as one of doubt and uncertainty in the wattle industry. Fortunately, conditions have not become as critical as was at one time feared, but it is abundantly clear that the days of easy affluence have gone, and are unlikely to return. Further, quality production and efficient management must become paramount considerations if wattle is to maintain its place in competition with other tanning agents for a market feeling the impact of synthetic materials.

In this situation, the research investigations of the Institute become more than ever important, for no longer can any producer afford to take a complacent view of low yields, poor quality, and the depredations of pest and disease. These problems are of the very essence of the Institute's work, and even at this early stage there is a wealth of advice and an ever-growing store of information available to the interested grower. It is to be regretted that, in general, greater use has not been made of them. Alive to the possibility that there will be cases where growers will wish to take marginal land out of wattle, the Institute is already investigating methods, as well as the economics, of substituting arable crops, possibly in a rotation.

Most of the lines of work, notably long term silvicultural experiments, the plant breeding programme, and fertilizer trials, must, by their very nature, proceed slowly to their appointed end, showing, in the meantime, little return for the time and thought invested in them. Pest control, however, has a higher potential for showing quick results, and at least one project, namely the attempt to control wattle bagworm by an artificially disseminated virus disease, is attracting widespread attention and showing not a little promise. Even here, however, several years of critical testing will be necessary before firm recommendations can be made.

Acute staff shortages, because of which some urgent projects have not been started and others have had to be suspended, continue to hinder and restrict the Institute's output. Nevertheless, the appearance of eleven publications in the scientific and technical press during the year constitutes a record of very satisfactory progress.

H. SHAW, *Director.*

October, 1958.

ADMINISTRATIVE REPORT

BUILDINGS AND PLANTATIONS

Main Building.

Following the acquisition of a fourth motor vehicle, it became necessary to provide additional garage accommodation and, in order to avoid an unsightly accretion of miscellaneous outbuildings, this need was met by an unobtrusive addition to the rear of the main building. Here, there is provision for housing two vehicles as well as certain items of bulky equipment for which hitherto there has not been adequate storage space.

Only very minor maintenance work has been necessary during the year, reflecting the present sound state of repair of the building.

Good progress has been made in cleaning up and laying out the surroundings. The bank along the north face of the building has been made up to the required height and levelled, and the necessary alterations to drains and grids have been made. Work is now about to start on laying a paved path and on building up a rock bank which will bring this section into harmony with the general plan for this part of the campus as expressed around the neighbouring Agricultural Research Institute building. The Institute is indebted to Mr. A. Fairall, Director of the City Parks Department, and his staff and to Professor le Roux, of the Faculty of Agriculture, for invaluable assistance in planning these developments. Both these friends have agreed to serve on an informal committee to advise on further steps in implementing these plans. The progress of this work has been greatly assisted and the cost much reduced by the use of Bloemendal farm equipment, kindly made available by the Field Experiment Station Committee of the Wattle Growers' Union.

The Public Works Department has taken steps to avoid the troublesome inundation of the approach road that has accompanied every heavy fall of rain. If these are successful, the result will be very much to the advantage and convenience of visitors and of the Institute staff.

Field Experiment Station.

The area felled in the season 1957–58 was 31 acres, somewhat less than in the previous year. Some 30 acres were laid down to new experiments, including about 4 acres of new land added to the genetics experiments. Fifteen acres of mature trees were sprayed against bagworm to facilitate stripping, and experimental spraying was also carried out.

Two of the demonstration houses for native labour were built and others will follow in the coming year. There will then be several comparable houses of approved types in various materials and methods of construction, with detailed costs of each available. Preparations for building the nearby dam have proceeded and construction should be completed in the current year.

In common with all wattle producers, the farm felt the full impact of the lower prices that prevailed throughout the year and the gross income was substantially reduced, resulting in the farm showing a small working loss. In view of the fact that much the greater part of the plantations consists of experimental plots, where profit earning can never be a major consideration, this position must be regarded as more nearly normal than the considerable profits made in past years.

ADMINISTRATION AND FINANCE

There were two changes in the membership of the Committee of Control during the year. In October, 1957, Mr. R. B. Fyfe resigned and was succeeded by Mr. S. J. F. Nuss. Mr. Fyfe had been a member of the Committee since 1948, but before that, had been closely associated with the establishment of the Institute and had always been one of its keenest and most interested supporters. He missed no opportunity of bringing the practical problems confronting the grower to the notice of the Institute staff, and it is a pleasure to know that his active association will be maintained through his membership of the Field Experiment Station Committee. In January, 1958, Mr. C. E. Lack, who had represented the Department of Forestry on the Committee of Control since 1952, was transferred to Umtata and was replaced on the Committee by his successor as Conservator of Forests, Mr. M. van N. Möhr. During his six years in office, Mr. Lack made a valuable contribution to the general management of the Institute and was particularly helpful as the link with the Department of Forestry.

During the Director's absence on long leave from March to August, Dr. Martin was in charge of the Institute and served on the Committee as Acting Director.

Three meetings were held during the year and at the first of these, Mr. S. Clegg and Prof. A. J. W. Bayer were re-elected as Chairman and Vice-Chairman respectively and Mr. H. H. Cornell was nominated as assessor member of the S.A.W.G.U. Field Experiment Station Committee.

A year ago, it was recorded that the Department of Agriculture had assumed responsibility for the Government's interest in the Institute. This arrangement, however, lasted for little more than six months, for in November, 1957, the Department of Forestry again took over as part of a general policy of bringing all wattle affairs within the purview of that Department. This change had the effect of temporarily halting the negotiations for increased Government support for the Institute, which had been proceeding with considerable promise of a successful outcome. When they were resumed, after a meeting of representatives of the Wattle Growers' Union, the University, and the Institute with the Secretary and Assistant Secretary for Forestry, the Treasury refused to sanction an increase and the grant remains at the level initially fixed some twelve years ago.

Expenditure and Income.

The new garage mentioned above accounted for £530 of the special expenditure during the year, while the purchase of an additional motor vehicle and replacement of another cost over £1,700. The payment of a vacation bonus at a total cost of £762 somewhat eased the position of the Staff, whose basic salary scales have not changed since 1953. Despite these large items, total expenditure for the year, though about £1,700 higher than in the previous year, was nearly £4,500 less than the estimate. This is due to the involuntary saving in salaries and laboratory costs arising from the persistence of three unfilled vacancies on the staff. There were, however, material reductions also in buildings maintenance and in travelling and subsistence expenses, and the amount spent on capital equipment was unusually small. The small item of income from analytical services was about the same as in the previous year.

The summarized statement of Expenditure and Income for the period 1st September, 1957, to 31st August, 1958, appears below. Detailed Accounts and Balance Sheet are published separately.

RESEARCH INSTITUTE ACCOUNT

1st September, 1957, to 31st August, 1958

Expenditure	£	s.	d.	*Income*	£	s.	d.
Research and Administrative Staff Salaries, etc.	19,800	2	2	S.A.W.G.U. Grant ..	20,312	15	8
Travelling and Subsistence	1,079	0	5	Department of Forestry Grant	5,000	0	0
Laboratory and Office Equipment and Maintenance	843	7	4	Analytical Services ..	69	6	0
New Vehicles (less trade-in)	1,734	10	0				
Library	306	19	11				
Printing and Stationery ..	243	6	5				
General Administration ..	769	6	5				
Building Maintenance ..	75	9	0				
Building Additions	530	0	0				
	£25,382	1	8		£25,382	1	8

STAFF

Throughout the year under review, there was no change in the European staff of the Institute, but immediately after its close, Mr. J. A. Hunt, a Junior Technical Assistant, resigned from the Entomology Section. Both the Director and Dr. Moffett were absent for a period on long leave and Mr. G. B. Wortmann, the senior Technical Assistant in the Entomology Section, was granted unpaid leave during the academic session to enable him to complete his work for a degree in the University of Natal.

Renewed advertisement in the Union and overseas of the posts vacant in the Institute brought little response and no suitable candidates were forthcoming.

Rearrangement of the duties of the African outdoor staff involved the addition of one junior; further additions will be necessary as the site development plan is implemented.

Miss Smith unfortunately suffered several spells of illness during the year, culminating in a prolonged absence at its close. During these periods and during holiday leave, Mrs. P. M. Allison carried on the office administration on a part-time basis. As these events occurred mainly during the Director's absence on leave, an unforeseen additional burden was placed upon the Acting Director. However, with the goodwill and co-operation of all the members of staff concerned, the difficulties were successfully met.

Several Natal University students were employed during vacation periods as temporary assistants in the Entomology Section.

No application was received for the Wattle Research Institute Scholarship for 1958.

ADVISORY WORK, COMMITTEES, CONFERENCES, ETC.

Advisory.

There was a perceptible drop in the number of advisory letters written (220), due in large measure to the reduced number (11) relating to Silviculture. Questions relating to bagworm infestations kept the number of letters (123) concerning insect pests at the usual high level. The overall decrease was accounted for by the smaller number of enquiries from Natal; there was a small increase in those from other provinces and from countries outside South Africa. These latter came from thirteen different countries among which Burma, Chile, and Paraguay appear for the first time.

The Silviculturist visited 28 growers' plantations, mainly in northern Natal, the eastern Transvaal, and Zululand, and also advised a number of growers and Government agricultural officers at a field day held near Goedgegun in Swaziland. Although the Entomologist paid rather fewer visits (44) than for several years past, the area covered was even wider than usual, ranging from Pondoland through the Natal midlands to northern Natal, the southeastern Transvaal, and Swaziland.

In the absence of any large parties, the number of visitors to the Institute was about normal at around 80. This number included a small party of staff and students from the Department of Forestry in the University of Stellenbosch, while among those who came from overseas were Professor J. H. Becking, of Wageningen Agricultural University, Holland, Professor C. Syrach Larsen, Director of the National Arboretum, Denmark, Dr. W. S. Lacey, of the Botany Department, University College of North Wales, Dr. Joyce Pringle, of the Department of Agricultural Chemistry, University of Durham, and Mr. N. H. Shaw, of the Australian C.S.I.R.O. Plant and Soils Laboratory, Brisbane. Several of these visits were the occasion of most useful discussions and of completely disinterested, and therefore invaluable, comment on the work and progress of the Institute. Other visitors came from the Argentine, England, Indonesia, Kenya, Switzerland, and Tanganyika.

As a result of experience in the past two years, the Annual Farmers' Field Day at Bloemendal was limited to one day, 13th March. About 80 visitors spent the morning in a general tour of the farm and after lunch, proceeded to the Natal Agricultural Research Institute where, by courtesy of the Director, the film "The Wattle Industry in Natal" and a series of colour slides illustrating wattle in Australia were shown. The large audience included, in addition to growers, many members of the Agricultural Research Institute and the Faculty of Agriculture. From time to time, visitors were conducted over the Field Station, one party comprising senior students of the Faculty of Agriculture in the University of Natal and another members of the Department of Forestry in the University of Stellenbosch.

Among the public bodies who have consulted the Institute for advice and information are the Union Government Department of Forestry and Division of Economics and Markets, the South African Railways, the South African Timber Growers' Association, the Department of Agriculture in Papua and New Guinea, and the Colonial Development Corporation. There have been the usual commercial and technical enquiries from banks and industrial organizations.

The analysis of samples of commercial wattle bark submitted by the Government Bark Inspector continued at much the same rate as in the previous year and the results obtained were again in substantial agreement with his visual estimate.

The Entomology Section was again responsible for the annual bagworm survey and for recommendations for commercial spraying. Some 2,800 acres were sprayed under the general supervision of the Head of the Section and the results were assessed on over 2,200 acres. Dr. Ossowski contributed, by invitation, an article in German on the wattle bagworm for a special commemorative number of the *Zeitschrift für angewandte Entomologie*.

The year was the best so far for publications from the Institute, eleven technical and scientific articles having appeared, most of them in journals of high international standing. Details are given on page 40 of this Report.

Increasing use of Institute facilities, particularly the Library, has been made by staff and senior students of the University. Several of the latter have been assisted in seminars and other projects by individual members of the Institute staff, while more formally, Dr. Moffett was appointed supervisor and internal examiner for a Ph.D. thesis to be submitted in the Department of Botany. The usual requests from schools for literature and specimens were in evidence.

Committees, etc.

In the absence overseas of the Director, his deputy Dr. Martin attended the Annual Meeting of the Research Advisory Council of the Leather Industries Research Institute held in Grahamstown in June, 1958. He also attended a meeting of the Wattle Technical Committee on the preceding day.

Either the Director or Dr. Martin attended all the meetings of the General Committee and three meetings of the Executive Committee of the Wattle Growers' Union. Dr. Martin attended the two meetings, one in Pretoria and one in Pietermaritzburg, of the special committee convened by the Department of Forestry to consider the current problems in the marketing of wattle bark. Dr. Shaw, as Chairman of the Steering Committee for the Wattle Timber Research Fellowship, attended the one meeting held during the year.

The Director and Mr. Sherry continued to serve on the Wattle Growers' Union Field Experiment Station Committee and the Royal Show Sub-Committee, while the Acting Director and Dr. Ossowski served on the Pest Control Sub-Committee. Mr. Sherry continued his work on the Fire Legislation Sub-Committee and also served for another year on the Committee of the Botanic Society of Natal.

Conferences, Lectures, Meetings, etc.

During his visit overseas, the Director attended two meetings of the Association of Applied Biologists and one each of the Food Group and the Pesticides Group of the Society of Chemical Industry. These provided invaluable opportunities of renewing professional contacts and discussing problems of mutual interest. He also visited a number of agricultural research stations and university and industrial research laboratories, where specific problems relating to both production and utilization of wattle were discussed. As a result of these visits, arrangements have been made for certain issues to be investigated along lines for which facilities and techniques are not available in the Institute. Wherever appropriate, staffing problems were discussed, but with little prospect of any immediate easing of the position.

Mr. Sherry attended the Seventh British Commonwealth Forestry Conference in Australia and New Zealand where, in addition to taking part in the general activities and discussions, he was a member of the technical committee on forest protection and on forest research and served as Secretary of the latter. After the Conference, Mr. Sherry undertook a seven weeks' tour of the areas of Australia and Tasmania in which wattle is indigenous. He collected information on response to environmental conditions, sent bark samples to the Institute for analysis, and arranged for the collection of seed from trees of particular interest. Mr. Sherry has since given illustrated talks on his tour to groups of growers in Pietermaritzburg, Piet Retief, Paulpietersburg, Kambula, Eshowe, and Harburg. A full account of the Conference proper is available on request and a report on the wattle investigations appears on page 28 of this Report.

Although unable to attend the meetings, Dr. Ossowski contributed papers to the Fourth International Congress of Plant Protection at Hamburg in September, 1957, and the First International Conference of Insect Pathology and Biological Control at Prague in August, 1958. He has also been invited to undertake the duties of Chairman of the Sub-Section of Insect Viruses at the Eleventh International Congress of Entomology,

to be held in Vienna in 1960, and to lead a Symposium on Insect Viruses. With the approval of the Committee of Control, Dr. Ossowski has accepted these assignments and will attend the Congress.

On the local plane, the Director took part in further discussions between growers and timber users with the object of solving some of the problems which hinder the wider use of wattle wood, especially for rayon pulp. These discussions led to collaboration and advice in a series of field trials on treatment and handling. Mr. Sherry gave a talk at Camperdown on fire protection and forest fire legislation and Dr. Ossowski addressed meetings at Flagstaff, Vryheid, Piet Retief, and Goedgegun (Swaziland) on various aspects of insect control.

LIBRARY

The addition of 21 books and 42 volumes of bound periodicals brought the totals to 304 and 366 respectively. The number of bulletins, reprints, etc. received, otherwise about normal, was increased to 395 by the large number of publications issued in connection with the Commonwealth Forestry Conference. The total now stands at 2,604. During the year, two new periodicals were added to the list of those received.

Thanks are due to The Natal Tanning Extract Company for the gift of "A Manual of Wattle Growing", by J. S. Beard, and to the Leather Industries Research Institute, Grahamstown, for a copy of Dr. S. R. Evelyn's thesis entitled "Some Physico-Chemical Aspects of Black Wattle Tannins".

ACKNOWLEDGEMENTS

The Institute gratefully acknowledges its indebtedness to the undermentioned.

To the Director of the Natal Agricultural Region for making available stone for building rock gardens around the premises.

To the Entomologists of the Commonwealth Institute of Entomology and of the British Museum (Natural History) for assistance in identifying entomological material.

To the Clan Syndicate Ltd. for placing a block of trees at the Institute's disposal for sampling trials.

To the Comec Mimosa Extract Co., Ltd., for facilities for handling the chipped bark in sampling experiments.

To the members of the staff of the Faculty of Agriculture in the University of Natal for helpful discussions and advice on a number of problems of mutual interest.

To all the growers who have placed portions of their plantations at the disposal of the Institute for experiments, and to those who have sent material for the Institute's insect collection.

REVIEW OF WORK IN PROGRESS

(a) SILVICULTURE

1. Thinning Experiments.

Further harvesting took place in experiments designed to determine, for different site qualities, the optimum final density in relation to rotation length.

Suppression relationships in these experiments were determined by comparison of the mean breast height diameters of a number of dominant trees in each plot equal to the smallest number of trees remaining in any plot of the heaviest thinning treatment in the series. This provided a more sensitive and accurate test of relative suppression than the method of comparing mean plot diameters which has been used previously.

(*a*) The second portion of experiment S.1 at Broadmoor (Wartburg district) was harvested in March, 1958, at nine years of age. At the same time, the remaining portions of the experiment, which are to be harvested at eleven and thirteen years of age respectively, were re-measured.

Results from the harvested plots were as follows:

Nominal density per acre at harvesting	Mean d.b.h. (inches)	Mean d.b.h. 300 dominants per acre (inches)	Mean percentage tannin content (moisture free basis)	Mean green bark yield (long tons per acre)	Mean tannin yield (long tons per acre)
800	4·70	5·95	36·68	10·26	1·75
700	5·08	5·95	36·35	11·82	2·01
650	5·10	5·73	38·40	10·50	1·94
600	5·43	6·15	36·73	10·57	1·85
550	5·55	6·20	36·15	10·73	1·85
500	5·85	6·35	37·60	10·70	1·95
450	6·10	6·55	38·88	10·25	1·94
400	5·95	6·23	39·08	8·09	1·53
350	6·45	6·55	39·93	8·18	1·60

	Dominant d.b.h.	*Tannin content*	*Bark yield*	*Tannin yield*
Standard error	0·16	0·75	0·59	0·10
Significant difference (P=0·05)	0·46	2·20	1·73	0·29
Significant difference (P=0·01)	0·62	2·98	2·34	0·40

Soil variation over the experimental area was considerable, and the design of the experiment did not permit great precision in evaluating treatment differences. Comparison of the mean diameters of the dominant 300 trees per acre in each treatment showed that plots at densities of 650 and more trees per acre were significantly suppressed in relation to plots standing at 450 or fewer. It may be assumed, therefore, that the maximum permissible density for this site on a nine-year rotation is in the vicinity of 600 trees per acre.

The percentage tannin content of the bark varied considerably from plot to plot within treatments, and so did not show the fairly straightforward correlation with density which was found in the first portion of this experiment harvested at seven years

of age. It was, however, significantly lower (P=0·05) in plots at densities of 700 or more trees per acre than in plots of 450 and fewer.

The bark yields of plots with 400 or fewer trees per acre were significantly lower (P=0·05) than those of plots with 450 or more, but there were no significant differences between the yields of plots over the density range from 800 to 450 trees per acre. An estimation by the method of least squares showed that the best quadratic curve for the data was one of the form $Y=8\cdot100+0\cdot997X-0\cdot0805X^2$, where $X=(\text{stand}-350)\div50$, and this indicated that maximum green bark yield should be attained at a stand density of 660 trees per acre.

A similar estimation for computed tannin yields gave the equation

$$Y=1\cdot567+0\cdot138X-0\cdot0126X^2$$

which indicated a maximum yield of tannin at a stand density of 623 trees per acre.

Analysis of the data from the plots still to be harvested showed that at nine years of age, plots at densities of 600 trees per acre and more were significantly suppressed (P=0·01) in relation to plots at densities of 500 and less.

(*b*) The first portion of experiment S.3 at Bloemendal (Pietermaritzburg district) was harvested in November, 1957, at seven years of age and gave the following results:

Nominal density per acre at harvesting	Mean d.b.h. (inches)	Mean d.b.h. 500 dominants per acre (inches)	Mean percentage tannin content (moisture-free basis)	Mean green bark yield (long tons per acre)	Mean tannin yield (long tons per acre)
1000	3·90	4·50	35·75	9·04	1·56
900	3·90	4·50	36·90	8·32	1·51
800	4·28	4·73	37·18	8·69	1·58
750	4·30	4·65	38·38	8·47	1·58
700	4·38	4·68	36·83	8·13	1·44
650	4·48	4·78	37·90	8·12	1·50
600	4·63	4·83	37·73	8·01	1·47
550	4·78	4·88	38·23	7·40	1·39
500	4·73	4·73	38·30	6·99	1·31

	Dominant d.b.h.	*Tannin content*	*Bark yield*	*Tannin yield*
Standard error	0·10	0·83	0·37	0·06
Significant difference (P=0·05)	0·29	2·41	1·08	0·18
Significant difference (P=0·01)	0·39	3·26	1·46	0·24

There was evidence in this experiment also of considerable soil variation, and analysis of the mean breast height diameters of the dominant 500 trees per acre in each treatment failed to bring out any clear-cut trend in suppression relationships. It would seem, however, from an examination of the dominant diameters, that the maximum permissible density on this site at seven years is about 800 trees per acre.

The percentage tannin content of the bark increased with decreasing density of stand from 1000 to 750 trees per acre and thereafter remained approximately constant over densitities from 700 to 500, as was the case in the first portion of experiment S.1 at Broadmoor harvested in 1956 (*vide* Report for 1955–1956).

Yields of green bark in this experiment, however, did not follow the same trend as those in the first portion of experiment S.1, but showed a more or less regular decrease with decreasing density of stand from 1000 to 500 trees per acre. The yield from plots standing at 1000 trees per acre was significantly higher (P=0·01) than that from plots at 550 trees per acre or less, but there were no significant differences between yields of plots over the density range from 1000 to 600 trees per acre. By the method of least squares, a quadratic curve was derived having the form $Y=7\cdot129+0\cdot350X-0\cdot0182X^2$, where $X=(\text{stand}-500)\div50$, indicating that maximum yield would be obtained from a density of 981 trees per acre.

The computed yields of tannin did not differ significantly over the range of densities from 1000 to 600 trees per acre, but a similar estimation to that above gave the equation

$$Y = 1 \cdot 327 + 0 \cdot 0639X - 0 \cdot 00434X^2$$

which indicated a maximum yield of tannin at a stand density of 868 trees per acre.

The remaining portions of this experiment, which will be harvested at nine, eleven, and thirteen years respectively, were also re-measured. Analysis of the mean diameters of a fixed number of dominants in each treatment showed that at seven years of age on this site, plots at densities of 700 and more trees per acre were significantly suppressed ($P = 0 \cdot 05$) in relation to plots at densities of 450 or fewer per acre.

(*c*) Experiment S.5 on the Clan Syndicate Estate (Albert Falls district) was re-measured in August, 1958. At six years of age, the dominants in plots at densities of 1000 and more trees per acre were suppressed in relation to those in plots at densities of 550 and fewer.

(*d*) Experiment S.34 at Bloemendal, also planned to determine optimum density in relation to length of rotation, but on a different design from that used in the above three experiments, was measured in December, 1957, at two years of age. Up to this age, there were no differences in the degree of suppression between plots over the range of densities represented.

2. Row Espacement Experiment.

Experiment S.20 was laid down at Bloemendal in December, 1953, to replace Experiment S.4 in which it appeared that site variations had obscured the effects of treatment. The design of the experiment was a triple latin square and the treatments were as follows:

A. Tree rows established at six-foot espacement.

B. Tree rows established at nine-foot espacement.

C. Tree rows established at twelve-foot espacement.

The experimental area was clean-hoed before the previous crop was stripped and again when the new crop was about three feet high. All plots were thinned similarly in four operations to 500 trees per acre. At four years of age, mean breast height diameters were as follows:

Espacement	Mean d.b.h. (inches)
Six-foot rows	3·84
Nine-foot rows	3·96
Twelve-foot rows ..	3·74

Standard error	0·028
Significant difference (P=0·05)	0·097
Significant difference (P=0·01)	0·146

Up to four years of age, plots at nine-foot espacement had a significantly larger ($P = 0 \cdot 05$) breast height diameter than plots at six foot, and these in turn had a significantly larger diameter than plots at twelve foot. Grass growth at this stage had been almost completely controlled in plots at six-foot espacement and partially in plots at nine foot, but was still fairly vigorous in plots at twelve foot.

3. Regeneration of Wattle in Frosty Areas.

Initial establishment of wattle plantations in areas subject to frost is often accomplished without loss, but the regeneration of such areas usually proves difficult, and two or three seasons may elapse after felling the previous crop before a satisfactory stand is secured.

Experiment S.36 was laid down at Moorburg (Estcourt district) in November, 1956, in order to test the practicability of regeneration under wattle shelterwood. The only

stand available for the experiment was somewhat densely stocked, and the crowns of the trees were consequently rather poorly developed. It was decided, therefore, to leave rather larger numbers of nurse trees per acre than is normally the practice in European forestry, and the numbers finally adopted were 60, 80, 100, and 150 per acre.

The nurse trees were selected so as to secure reasonably regular distribution over each plot, and the remainder of the stand was felled and stripped. Brushwood was piled on the contour, with frequent breaks in the piles to permit drainage of cold air down the slope, and all advance growth and ground vegetation was hoed out. A certain amount of natural regeneration appeared before the winter, but most of this was killed by frost, and in October, 1957, only a few seedlings growing immediately under shelterwood trees or near large stumps were found to have survived.

In November, 1957, seed drills were prepared on the contour at nine-foot espacement and treated seed was sown with a dressing of approximately 200 lb. of superphosphate per acre. The resulting germination was rather irregular, but a considerable quantity of natural regeneration appeared and there was an adequate stand in May, 1958, just before the first winter frosts occurred. The crowns of the nurse trees had developed greatly as a result of the increased growing space available to them and appeared likely to give considerably more protection than was the case during the preceding winter.

In August, 1958, some of the larger seedlings resulting from sowing had been frosted, but the majority of these had survived the winter. The greater proportion of the naturally regenerated seedlings, which were less than twelve inches in height at the beginning of winter, had been killed by frost and only those which were taller than this had survived. The numbers surviving in the respective treatments were as follows:

Treatment	Numbers of seedlings per acre surviving after 1958 winter
60 nurse trees per acre ..	733
80 nurse trees per acre ..	1058
100 nurse trees per acre ..	815
150 nurse trees per acre ..	1638

Standard error 304
Significant difference (P=0·05) 1052

None of the differences between treatments was significant, but the numbers of seedlings surviving in all treatments were sufficiently great to justify confidence in the use of wattle shelterwood as a potentially practical means of securing regeneration in cold areas.

It is proposed to re-sow blank areas in these plots with treated seed at once, and later in the summer to strip the nurse trees standing in order to provide further information on the efficacy of dead trees as a shelterwood against frost damage.

A pilot trial had been carried out in March, 1957, when 50 trees per acre were stripped standing to serve as nurse trees in the regeneration of a plantation in a frosty area near Panbult in the Transvaal. It was hoped that these dead standing trees would provide a sufficient barrier to radiation from the soil without the disadvantage of root competition, which is unavoidable when living nurse trees are used. The seedlings under the dead shelterwood, as well as those in an adjacent unprotected area, were small enough during the winter of 1957 to escape frost damage, but had reached a height of about four feet by the beginning of winter in May, 1958. At the end of August, 1958, an inspection showed that most of the seedlings in both protected and unprotected areas had been killed, though the degree of survival was slightly higher under the shelterwood. It is obvious, however, that 50 nurse trees per acre were not sufficient, and it is hoped that the greater numbers available in the experiment at Moorburg will be found to cover the minimum shelterwood requirement.

4. Use of Wattle in Arable Crop Rotations.

Experiment S.40 was laid down at Bloemendal in October, 1957, to investigate the possibility of using wattle in rotation with arable crops or pasture so as to utilize the very considerable quantity of nitrogen added to the soil during the life of a wattle crop.

The site chosen for the experiment had been under wattle until about thirty years ago, when the standing crop was felled and the land stumped and brought under the plough. Maize crops were then taken off this land annually for nearly twenty years, during which time the fertility declined until the maize yields had decreased to a point at which it was considered uneconomic to continue cropping the land. Some eleven years ago, therefore, it was left fallow, and in due course, a volunteer crop of wattle developed from the seed which had lain in the soil since the earlier wattle crop was felled. This stand was thinned to a density of 500 stems per acre, and when stripped at ten years of age in the 1956–57 season, produced an average yield of 7·7 tons of green bark per acre. The land was then stumped by hand at a cost of £4 10s. 0d. per acre, ploughed in June, and left fallow until October, when it was again ploughed and disc-harrowed ready for sowing, the brushwood having been stacked on the contour and left unburnt. Crops were then established on plots one quarter of an acre in area, replicated four times, as follows:

A. Maize sown in November and spaced to twelve inches apart in three-foot rows for grain production. Fertilized at sowing at a rate of 60 lb. P_2O_5 and 90 lb. K_2O per acre (315 lb. superphosphate+150 lb. muriate of potash).

B. Maize sown in November and spaced twelve inches apart in three-foot rows for grain production. Fertilized at sowing at a rate of 60 lb. P_2O_5 per acre (315 lb. superphosphate).

C. Maize sown in October and spaced to nine inches apart in three-foot rows for silage production. Fertilized at sowing at a rate of 60 lb. P_2O_5 and 90 lb. K_2O per acre. The silage crop to be harvested in January and the ground to be reploughed immediately and planted to swedes in rows eighteen inches apart. The winter root crop to be fertilized at sowing at a rate of 60 lb. P_2O_5 and 90 lb. K_2O per acre.

D. *Eragrostis curvula* sown in early December. Fertilized at sowing with a 50 : 50 mixture of rock and superphosphate at a rate of 400 lb. per acre. In subsequent years, an annual dressing to be applied in spring at a rate of 300 lb. superphosphate+50 lb. muriate of potash per acre.

Having been sown rather late in October, the maize silage crop was not ready for harvesting in January as had been intended and was, in fact, not harvested until early March. The land was reploughed at once and the swedes were sown by mid-March, but this proved to be too late and the winter root-crop failed completely. The grass ley developed slowly and only one cutting was possible before winter. The grain crops developed normally and were harvested in June.

The yields of the various crops were as follows:

Treatment	Yield lb./acre	Equivalent	Estimated value per acre
A	2298·5	11·49 bags	£15·589
B	2070·5	10·35 bags	£15·529
C	27323·0	13·66 tons	£9·147
D	689·3	0·34 tons	£1·379

Standard error	0·391
Significant difference (P=0·05)	1·352
Significant difference (P=0·01)	2·047

The value differences between crops were highly significant (P=0·01), the grain crops providing an appreciably higher financial return than the silage or hay crops. The higher yield in grain plots receiving potash was, however, offset by the additional cost of fertilizer and the value differences between these plots were not significant. The yields of grain were approximately 40 per cent. higher than those normally obtained from the arable lands on the farm in the past, and the value of the additional yield slightly exceeded the cost of stumping. Thus, if yields continue over the next three years to exceed average past yields, the work of stumping will have been amply justified in terms of additional grain production.

(b) GENETICS AND PLANT BREEDING

1. Inbred Lines.

(*a*) *Black wattle.* There are now some 60 first generation inbred lines at Bloemendal and some of these have reached the stage when further work can be carried out. Towards the end of last year, lines planted in 1952, 1953, and 1954 were examined and selections made. As was to be expected, the inbred lines continue to show considerable uniformity within each family, but there are marked differences between families. Two to ten selections have been made in a number of lines, giving a total of 73 selections covering 26 families. Selection was based initially on tree form and freedom from disease. Quarter-height samples of bark for tannin analysis were then taken from 59 of these trees and the results of the analyses used as further criteria for selection. Analysis of these bark samples showed that in all families except one, the mean tannin content of the family was less than the tannin content of the respective parent trees, but this may be due to the difference in age between the parent trees and their progeny.

(*b*) *Green wattle.* The families of green wattle comparing open-pollinated progeny of a number of trees with their second inbred generation were scored for the second time for diameter. As is to be expected, the relative differences between the selfed and the natural progenies followed the same general pattern as that found in the previous scoring (Report for 1952–1953), but, excluding tree G.28, the percentage differences in diameter were greater.

2. Progeny Testing of Selected Trees.

(*a*) *Seventh progeny trial* (*planted 1957*). In October, 1957, seed of 49 families was sown for a further progeny test in which was included a number of strains of black wattle direct from Australia, as well as local single tree selections. Transplanting to the field took place early in January and resulted in a moderately good stand. Despite heavy frosts, none of the trees seemed to be damaged. Following the practice of the past few years, the whole trial was enclosed by wire netting, but there has still been a certain amount of damage by hares.

As the trees were still very small, no height scoring was attempted.

(*b*) *Sixth progeny trial* (*planted 1956*). This trial, which was frosted during July, 1957 (Report for 1956–1957), was examined at intervals to assess the degree of damage. This proved to be more severe than was at first thought, and scarcely a single tree escaped without being affected to a greater or lesser extent.

The trial was scored in detail, not only for the number of trees damaged, but also for the degree of damage to each tree. Analysis of these results showed that there was no indication whatsoever of differences between families for susceptibility to frost.

In spite of the frost damage, the stand in July of this year was still fairly good, but because of the uneven and abnormal growth, it was felt that no worthwhile comparisons could come out of the trial. It has, therefore, been decided that all trees will be pulled out and the trial replanted in a modified form during the coming season.

(*c*) *Fifth progeny trial* (*planted 1955*). During the year, all the trees in this progeny trial were scored for height, diameter, gummosis, forking, and branching characteristics. The differences between families were highly significant for both height and diameter, the means being 31·6 feet and 3·1 inches respectively. A strong correlation ($r=0·8373$, with 47 degrees of freedom) between height and diameter indicated that some families were definitely more vigorous than others. The branching characters have not yet been analysed statistically, but from observations in the field during scoring, it seems that there were differences between the families.

(*d*) *Fourth progeny trial* (*planted 1954*). Diameters and branching characteristics were scored in this trial during April. Analysis of diameters showed highly significant differences between the families. So far, this is the only trial in which a detailed analysis of the branching characters has been carried out. The quantity of lateral branches on each tree was scored as numerous, moderate, or sparse, while the type of lateral branch was scored as heavy, medium, or light. There were highly significant differences between families both for quantity and for type of lateral branches. A summary of the branching for the whole trial is given in the table below.

	Observed				Expected		
	Numerous	Moderate	Sparse	Total	Numerous	Moderate	Sparse
Heavy ..	149	114	43	306	118·1	123·5	64·4
Medium..	192	173	99	464	179·1	187·2	97·7
Light ..	55	127	74	256	98·8	103·3	53·9
Total ..	396	414	216	1026	396	414	216

$\chi^2=50·300$

This table shows the strong association between quantity and type of lateral branching. Thus on a tree where the lateral branches are heavy, they are more likely to be numerous than sparse, and so on. The majority of trees, however, were average, i.e. they had a moderate number of branches of medium type.

With the aid of general descriptions and photographs, the branching of the parent trees for this trial has been scored in a similar manner to that of the progeny. The majority of these parent trees were, however, border trees and, therefore, their lateral branches tend to be rather heavier than would be expected under normal conditions in a plantation. Thus, all parent trees scored as "heavy" had, with one exception, a majority of trees with only "medium" lateral branches in their progenies. The lateral branches in the progeny of the three parent trees scored as "light" were predominantly light. The quantity of branches was in most comparisons either "numerous" or "moderate" in both parents and progeny. Tree 93, however, was scored as "sparse" while its progeny is mainly "numerous". On the other hand, tree 80 was "moderate" with progeny predominantly "sparse". Although there appears to be a tendency for the branching characters of the parent to be passed on to its open-pollinated progeny, as yet, no real relationship has been established.

(*e*) *Felling of selected trees.* A further 20 trees of approximately 10 years of age that have been used as parents for progeny testing were felled during April of this year. These trees had a mean height of 49·5 feet, with a range of 44·0 to 61·0 feet, and a mean diameter of 9·2 inches, the range being 6·9 to 12·0 inches. A wide variation in the strippable bark weight and the percentage of tannin also occurred, the means being 105·7 lb. and 45·6 per cent. and the ranges 69 to 166 lb. and 40·5 to 52·1 per cent. respectively. In this group of trees, there was no correlation between the diameter of a

tree and the percentage tannin in its bark ($r=0\cdot323$, 18 d.f.). Bark thickness also was not related to the tannin percentage of a tree ($r=0\cdot3905$, 18 d.f.), therefore bark thickness is not reliable as a guide to tannin content.

From information on tannin sampling obtained from the Chemistry Section, it seemed likely that a bark sample taken at approximately quarter-height of the tree would give a fairly good estimate of the average tannin content of individual trees. Therefore, just before felling this group of trees, a vertical strip of bark roughly 18 inches long by 4 inches wide was removed from the quarter-height region of each tree and analysed separately. Comparison of these results with those of the total bark analysis, which may be taken as giving the true tannin content of the trees, showed that there was no significant difference between the two. The ranking of these trees in descending order of tannin content on the quarter-height samples was tested against the true ranking on the total bark results by using Spearman's rank correlation coefficient method. This correlation was highly significant ($t=3\cdot762$ with 18 d.f.). On these results, the quarter-height sample of bark for tannin analysis is very encouraging, but further tests must be made before assuming that it will hold for all trees. From the practical point of view, these quarter-height samples present no difficulties and are relatively quickly taken.

(*f*) *Selection of trees for progeny testing.* Some 50 trees have been selected, chiefly in families derived from single tree selections made in December, 1951. The original parent trees were felled in 1955 and 1956 and their bark weighed and analysed for tannin, and these factors have been taken into account in making selections in their progeny. Apart from the characteristics of the parent trees, selection has had to be confined in the first place to tree form and freedom from disease, but from the encouraging results of the quarter-height sampling described in the previous section, it seems likely that in the future, it will be possible to eliminate all trees of low tannin content in the selections. Thus, as well as collecting seed and air layering for propagation, a quarter-height sample of bark for tannin analysis was taken from 35 of the trees selected. Results of the analyses of these samples showed that the tannin contents of the selected trees ranged from 31·8 per cent. to 45·5 per cent. with a mean of 39·2 per cent. These results were, however, not independent of the diameter and the bark thickness of the trees ($r=0\cdot4013$, 35 d.f. and $r=0\cdot4057$, 34 d.f. respectively).

(*g*) *Forking of trees in progeny trials.* The incidence of forking has now been scored in four of the progeny trials. In the first three of these, a great deal of the forking was thought to be due to damage, especially by hares when the trees were very young. In the fifth progeny trial, however, the whole trial was enclosed by wire netting, so virtually none of the forking can be attributed to rodent damage. In all the trials, the trees were planted at their final spacing and no thinning took place, but in the second trial, instead of transplanting the seedlings from pots, the seeds were sown in their position in the field.

Individual trees were scored as being forked at the base, the middle, and/or the top, but in the first analyses of the results, no account was taken of the position of the forks and the trees were regarded as having either forked or single stems. It was thought that this might have obscured differences between families, and for subsequent analyses, the forked trees were divided into two groups, viz. those forked below breast height (B.H.) and those forked above breast height. Trees forked both below and above B.H. were included in both groups.

In all four of the trials, there were significant differences between the families for forking below B.H., but forking above B.H. was significant only in the first two trials. It appears, therefore, that the tendency to fork is to some extent, at least, inherited. Only in the fourth trial was there some evidence of association between forking below B.H. and forking above B.H. A summary of the forking in the four trials is given in the table below.

Trial number	Trees forked above B.H.		Trees forked below B.H.		Trees forked above and below B.H.		Trees not forked	
	Range between families %	Mean of trial %	Range between families %	Mean of trial %	Range between families %	Mean of trial %	Range between families %	Mean of trial %
1	10·1—35·7	20·8	6·1—29·1	17·7	1·4—16·3	7·2	32·4—73·2	54·3
2	16·0—60·5	34·6	1·3—15·8	7·5	0—20·5	4·1	28·9—70·6	53·8
4	7·5—29·3	18·1	8·1—31·0	19·8	0—21·4	10·0	23·8—75·0	52·0
5	2·8—42·9	20·2	0—33·3	8·5	0— 9·1	2·1	48·5—91·7	69·1

None of the parent trees selected for these trials was forked below breast height, but several, deliberately selected, were forked above. In most cases, forked parent trees gave progeny above average for forking, but on the other hand, several non-forked parent trees also gave a high percentage of forked trees in their progeny. Two forked parent trees had progeny with only 17·1 per cent. and 8·1 per cent. forking respectively, i.e. well below average. It was not possible, therefore, to establish a relationship between forking or otherwise in the parent tree and in its progeny.

3. Vegetative Propagation.

The air layering method used for the propagation of wattle trees has so far provided rooted layers from some 140 selected trees and hybrids, but it has certain disadvantages and limitations. The layers rooted annually varied from approximately 30 per cent. in poor seasons to over 80 per cent. in good seasons. One serious limitation, especially from the point of view of tree selection, has been the difficulty in rooting air layers on well-grown trees under normal plantation conditions. The lower branches, which hitherto have mainly been used for air layering, are quickly shaded out, while the placing of air layers on the thin, outer ends of upper branches has proved to be almost impossible. In an attempt to overcome these difficulties, different placing of the air layers was tried on several trees in the nursery. Thick branches, sufficiently long to reach up to and form part of the crown and, therefore, not subject to shading, were chosen. The air layer was placed at the lower end of the branch at a point about one foot from the main stem, so that working conditions were relatively easy using a ladder and a safety belt. Some of the branches chosen were over 15 feet in length and over $2\frac{1}{2}$ inches in diameter at the point of layering. Branches, which rooted freely, were sawn off about one foot above and immediately below the air layers and the rooted sections transferred to pots, where they are growing satisfactorily.

This modification of the air layering technique, although rather slow, has greatly facilitated vegetative propagation of difficult trees and during the year under review, the majority of trees propagated have been layered at heights of from 30 to 40 feet above the ground. The success of these (nearly 80 per cent. rooted to date) has also dispelled any fears that the rooting potential of high branches is not as good as that of low branches.

Another disadvantage of the air layering method of vegetative propagation is that the number of layers than can be put on any one tree is very limited, and to obtain clones of any reasonable size is a long and tedious task. Because of the importance of vegetative propagation in the tree breeding programme, budding and grafting were again attempted in spite of the failure of earlier workers to achieve any success by these methods.

Owing to lack of suitable stock material, only a few trials have been made so far. The simplest methods of shield budding and cleft grafting have been attempted on all the suitable material available in the nursery, but as yet, no success has been achieved. One difficulty experienced has been that of gummosis where the stock is cut to insert the bud. This, however, is probably seasonal and it is hoped to avoid it by budding in early spring.

The buds remain green and apparently alive in many cases for more than four weeks, but so far, only one of the buds seems to have partially taken. Grafting has been attempted only on young seedlings. The grafted scions also stayed alive for several weeks, but none of them showed any signs of taking.

The fact that the buds apparently stayed alive for such a long time gives some encouragement for the future. Suitable stock material has now been established in pots in the nursery and further attempts at budding and grafting will be made at intervals during the year.

(c) CHEMISTRY

1. Fertilizer Experiments.

(*a*) *Major factorial experiments.* The experiment on Table Mountain Sandstone was not measured this year because it is due to be harvested during the coming stripping season, and actual yields will then be available. Gale damage to the experiment on dolerite made it impossible to obtain heights accurately. The estimated bark weights had, therefore, to be calculated on a diameter basis, whereas previously, heights were also taken into account. For the sake of uniformity, the results from the shale experiment are given on the same basis. It is interesting to note that the results are in close agreement with those presented last year, thus indicating that the estimates are equally valid.

Estimated mean bark weight in relation to treatment
(No treatment=100)

Soil-parent material	Nitrogen	Phosphorus	Potash	Lime
Shale	100	115**	114**	110**
Dolerite	98	111**	101	110**

**Differences significant (P=0·01)

Phosphate and lime improved yields on both soils, but potash was effective only on shale.

(*b*) *Different forms of phosphate.* As in previous years, there was no significant difference between the effects of different forms of phosphate.

Estimated bark weights as percentage of mean

Treatment	On dolerite	On shale
Superphosphate	102	108
Super-raw (3:1)	100	103
Langfos	97	96
Moroccan rock	99	94
Calcium metaphosphate ..	102	99

(*c*) *Quantity of superphosphate and method of application.* In this experiment, six rates of application of superphosphate are combined with four methods of application. The rates are 0, 50 lb., 100 lb., 200 lb., 400 lb., and 800 lb. superphosphate per acre.

The methods of application are:

A. Half under the seed before sowing; remainder between the lines one year later.

B. Half in bands on either side of the seedling lines at first thinning; remainder between the lines one year later.

C. All under the seed before sowing.

D. All in bands on either side of the seedling lines at first thinning.

Estimated bark weight in lb. per tree

Treatment	Superphosphate lb./acre						Mean
	0	50	100	200	400	800	
A	17·5	17·6	17·7	18·7	19·6	20·6	18·6
B	17·4	18·2	18·2	18·4	20·3	20·3	18·8
C	17·9	17·3	18·2	20·2	21·4	21·5	19·4
D	18·6	18·3	17·9	19·9	21·2	21·1	19·5
Mean	17·9	17·9	18·0	19·3	20·9	20·9	

The only significant differences revealed are in the amount of superphosphate applied, with an optimum economic dressing of about 200 lb./acre. It seems immaterial whether this amount is applied under the seed or in side bands. Experience at Bloemendal indicates that application under the seed leads to greater weed growth, especially grass, in the tree lines, with consequent disturbance of the root system even when the weeds are hand pulled. Application in side bands at first thinning is, therefore, now advised. Many growers have reported that application under the seed in late re-establishment (January and after) does not lead to excessive weed growth.

(*d*) *Gummosis.* Counts of gummosis damage in all the above fertilizer experiments revealed no significant differences due to fertilizer application.

2. Bark Analysis.

(*a*) *Routine analyses.* Bark samples analysed during the year numbered 1160. Of these, 32 were submitted by the Government Inspector of Wattle Bark, whose visual gradings were again in substantial agreement with the results of analysis. Some 167 samples were analysed for the Genetics Section and 6 samples were sent from Australia by Mr. Sherry. The remainder were all collected in the course of investigations on sampling methods.

(*b*) *Tree and plot sampling.* During the year, two Silvicultural thinning experiments and two Entomological bark-increment experiments were harvested. In each case, different stratified random pellet samples were taken for comparison with those obtained by means of the sampling machine previously described (Report for 1955–1956, p. 22).

3. Seasonal Effects on Extractives in Wattle Bark.

The main conclusion from this work was given in last year's Report. During the year, the results were subjected to more rigorous statistical examination and a paper has been prepared for publication.

4. Variation of Percentage Tans and Non-tans with Age.

This experiment consists of 196 one-eightieth acre plots, each of six trees, laid out in four blocks, each of 49 plots. Four plots taken at random, one from each block, are to be harvested six times a year, namely every six weeks commencing from the middle of October, until the trees are ten years old. The first harvesting took place on the 15th October, 1957, when the trees were two years nine months old. Each tree was measured for diameter, height, and bark weight when felled, and the bark was subsequently analysed.

It will not be possible to draw even tentative conclusions from the results until several years have passed, since in any one year, seasonal effects may well outweigh the progressive effects of age. For this reason, no figures are presented here.

5. Chemical Composition of the Non-tans.

The work on the carbohydrate fraction of the non-tans was continued from June, 1958, onwards. There are indications that the unidentified crystalline solid mentioned in the last year's Report may be a polyalcohol, m.p. 188°, $[\alpha]_D^{20} + 71°$. It does not form a crystalline acetate and is unaffected by dilute mineral acid. It has a relatively low R_F in butanol : acetic acid : water (4 : 1 : 2·2) and the best reagent for spot location was found to be the periodate/benzidine reagent (Mowery, *Anal. Chem.*, 1957, **29**, 1560). Analysis gave C=42·9, H=7·02%, figures which have not been identified with any particular polyalcohol.

A further small amount of polysaccharide material was obtained from the charcoal column by eluting with 20% aqueous ethanol. This fraction contained sucrose together with other components which have not yet been satisfactorily separated on paper.

A comparison of bark from the tree Bloemendal 463 (winter bark) with bark obtained from trees harvested at the height of summer shows that in the carbohydrate fraction, the components are essentially the same, although the concentration is less in the summer bark. Bloem. 463 bark had a non-tan value of 18·6%, whereas the non-tan in summer bark was 11·8%. The following carbohydrate concentrations were obtained from the two samples:

	Bloem. 463 bark	*Summer bark*
"Polyalcohol", glucose, and fructose	5·8%	1·9%
Sucrose and unknown	2·5%	1·4%
Total	8·3%	3·3%

The drop in non-tans during the stripping season would appear to arise from the reduction in the carbohydrate concentration due to the more rapid turnover of these constituents in the normal metabolic processes during the summer season.

The investigation of the non-tan carbohydrates was temporarily suspended to enable work on the polyphenolic fraction to be started. In the past, various extraction methods have been employed in an attempt to separate this material from the carbohydrate fraction, but without any success. The extraction of solid extract with ether in a Soxhlet apparatus was partially successful, but due to the slow rate of extraction, the low solubility of the material in ether, and the subsequent decomposition of the material due to heat during the extraction, this method was held in abeyance.

Roberts *et al.* (*J.Sci.Food Agric.*, 1956, **7**, 637) precipitated the flavonol components from tea extract with lead acetate in alkaline solution. This method was applied to an aqueous extract obtained from Bloem. 463, and a yellow precipitate which tended to darken slightly during filtration was obtained from alkaline solution. When, however, this method was carried out on an extract solution obtained from summer bark, both the filtrate and precipitate darkened rapidly immediately the pH was raised.

The flavonol fraction obtained from Bloem. 463 contained components which fluoresced under ultraviolet light. Two of these could also be located on a chromatogram with the vanillin/HCl reagent, but with the solvents used by Roberts *et al.*, they could not be clearly separated. These components will be further investigated by the methods detailed by the above authors when suitable filter paper is available.

(d) ENTOMOLOGY

1. Effect of Bagworm Attack on Increment.

Increment plots were checked at the end of 1957 and again examined and measured in co-operation with the Silviculture Section during July, 1958. Two more sets of plots were harvested and the bark weighed. The results, together with those from three other plots harvested in previous years, are given below.

Site class	Time and degree of bagworm attack		Crop harvested at	Loss of green bark tons/acre
	partial defoliation at	complete defoliation at		
2	5y. 6m		8y. 9m.	0·10
3		2y. 9m. & 3y. 9m.	9y. 9m.	0·98
3+		5y. 10m. & 6y. 10m.	8y. 1m.	1·27
3+		6y. 10m.	8y. 1m.	0·58
2−		8y. 9m.	9y. 9m.	0·64

A full report on this experiment will be published after all the plots have been harvested, probably in 1962.

2. Parasites of Wattle Insects.

A hymenopterous parasite, *Mesocomys* sp. nr. *vuilleti* Crawf. (*Eupelmidae*) was found in eggs of the Wattle Emperor Moth, *Gynanisa maia* (Klug).

3. Chemical Control.

(*a*) *Small scale experiment.* A small-scale, replicated, spraying experiment was carried out to test the efficacy of three different insecticides against bagworms in both earlier and later instars. An account of this experiment is given on page 37 of this Report.

(*b*) *Commercial spraying campaign, 1957–1958.* Approximately 4,000 acres were surveyed for this campaign and over 2,000 earmarked for spraying. In all, 2,814 acres were sprayed and the application was supervised and the outcome assessed over an area of 2,231 acres. The insecticide used was toxaphene dissolved in light diesel oil at the rate of 0·75 lb. per gallon of solution; 2,060 acres were treated with three gallons and the remainder with two gallons per acre. The campaign started on the 26th October and ended on the 27th November, 1957, with a break from the 28th October until the 14th November. In all, there were 14 spraying days, the actual time of flying and spraying being 43 hours, or somewhat more than three hours per day. The usual daily total was from 180 to 200 acres, i.e. approximately one acre per minute of flying time, irrespective of whether two or three gallons per acre was used. Only 115 acres, some 4% of the total area sprayed, showed an unsatisfactory kill after operations. Of these, 50 acres were inadequately covered due to operational shortcomings; in the remaining 65 acres, the failure was traced to biological factors.

(*c*) *Commercial spraying campaigns, 1952–1956.* The effect of these campaigns on wattle plantations and the cycle of bagworm infestation is being studied and will probably be concluded during 1959–60.

(*d*) *Effect of insecticidal spraying on wattle insects other than bagworms.* Ten window flight traps were erected in a large plantation in the Albert Falls area five weeks before the commencement of aerial spraying, five being placed in that part of the plantation which was to be sprayed and five in the part to be left unsprayed. Insect material is being collected from these traps at intervals, recorded, identified, and classified as beneficial, harmful, or indifferent.

The number of insects collected up to August, 1958, i.e. nine months after the plantations were treated, was always lower in the plantations treated with insecticide,

except in the seven days immediately after spraying. Collection will continue for another season.

A second set of traps will be placed this season in a plantation in the Eston-Richmond area.

4. Biological Control (Virus Disease in Bagworms).

(*a*) *Experiments, 1956.* The outcome of these experiments was assessed and it was found that there was no marked difference in the overall kill whether higher or lower concentrations were used. Mortality due to polyhedrosis alone, however, was somewhat lower after the use of the latter. Mortality was highest up to the second instar, and more females than males succumbed to the disease. The kill was lower in plantations in which suspensions prepared from local virus material were sprayed than where virus introduced from a distant source was used, but even where the kill was lower, mortality was still high enough to prevent serious defoliation of the trees. Virus artificially disseminated may not only cause epizootics in the treated plantations, but may spread to neighbouring blocks in the year following treatment. A full account of these experiments is contained in a paper presented to the First International Conference of Insect Pathology and Biological Control in Prague.

(*b*) *Experiments, 1957.* Over 500 acres in various parts of the wattle-growing area were sprayed by plane with virus suspensions. The experiments were designed to test the efficacy

(i) of suspensions sprayed before and after hatching of larvae,

(ii) of suspensions of various concentrations,

(iii) of suspensions with and without adjuvants,

(iv) of virus material prepared from local and introduced stock, and

(v) of less- and highly-virulent virus strains.

From an interim assessment of the outcome, it appears that a satisfactory kill may result from applying concentrations below 1,000 polyhedra/cu. mm. The interim assessment seems also to confirm the findings of the 1956 experiments regarding the difference in mortality due to virus suspensions prepared from local and from introduced stock.

5. Identification of Wattle Insects.

Two insect species hitherto not recorded as potential wattle pests were observed damaging plantations and identified. Further details of these insects are given on page 34 of this Report.

6. Records of Insect Outbreaks.

The records at present contain data concerning 51 species on 247 farms.

7. Wattle Insect Collection.

This collection, started in 1953, now contains 257 species.

(e) BIOMETRY

The work of this section is inextricably bound up with that of the other sections and is embodied in their reports. It has included the design and analysis of experiments for the Chemistry and Silviculture Sections, the analysis of results from investigations into the effects of rainfall on tan and non-tan percentages, and an investigation of sampling methods.

(f) MISCELLANEOUS

1. Control of Fungal Infection on Wattle Wood.

The rapid growth of fungi on newly-felled and stripped wattle trees is a phenomenon which militates strongly against the use of the wood as a raw material for rayon pulp. A preliminary test showed that while 0·1% copper sulphate solution was ineffective, a 5% solution of pentachlorophenol was very promising in restraining this growth. About a ton of logs was consequently treated with this latter solution, applied as a fine spray at the rate of approximately 0·5 gall. per ton, and railed to the factory for processing. Two sample logs kept in the plantation for observation were still quite clean after four weeks, whereas untreated logs were liberally spotted with fungus colonies within two days, and after a week, were almost completely covered.

At the same time, a few logs were treated with 1% pentachlorophenol (i) in solution in paraffin, and (ii) in aqueous emulsion. After the logs had stood in the plantation for three weeks, there was no more than an insignificant spotting with mould on either lot. In another trial, newly felled, untreated logs were stacked and covered with brushwood. The amount of mould growth was thereby very materially reduced, though it remained greater than on treated logs.

In the course of these experiments, it was noted that the rate and intensity of both mould infection and discolouration varied greatly with the prevailing weather conditions.

2. Pre-emergence Weed Control in Wattle Plantations.

A small exploratory trial was carried out to determine whether germinating wattle could be kept free of weeds without damage to the wattle seedlings. Duplicate small plots were treated with several potential control materials, one of which gave promising results. Very few weeds had appeared when heavy frost supervened five months after treatment, whereas the wattle appeared to be unharmed.

3. Collaboration with Other Organizations.

(*a*) *Survey of fungi affecting wattle wood.* Samples of freshly-felled timber were collected at the request of the National Chemical Research Laboratory and sent to the Division of Botany in the Department of Agriculture for examination.

(*b*) *Ring counts as an indication of age.* At the request of the Department of Forestry, the possibility of using ring counts to determine the age of trees was investigated. The difficulty and uncertainty of the counts seem to rule out the method as a practical proposition.

PROGRESS REPORTS AND PAPERS

REPORT ON A TOUR OF BLACK WATTLE AREAS IN AUSTRALIA

By S. P. SHERRY

Introduction

The purpose of this tour, which took place during October and November, 1957, was to study the behaviour of black wattle in its native habitat, as well as the sites on which it occurs, and to collect seed from trees of good type over the entire natural range of the species. It was hoped by means of these seed collections to obtain a supply of breeding material containing genic combinations not present in black wattle in South Africa, and to determine whether clinal forms, particularly in respect of cold tolerance, have developed in Australia.

The tree known as black wattle in South Africa has been described variously in the literature as *Acacia decurrens* Willd. var. *mollis* Lindl. and, more recently, as *Acacia mollissima* Willd. Recent research, however, by Miss M. Tindale at the National Herbarium in Sydney, indicates that neither of these names is correct. Since no new name has yet been proposed for the species, the common name "black wattle" will be used throughout this report.

Natural Range.

Black wattle is confined to the south-eastern portion of the mainland and occurs naturally elsewhere only in Tasmania. The limits of its range are, roughly, from 34° to 43° S. latitude and from 138° to 151° E. longitude, which includes the south-east of South Australia, the whole of Victoria and Tasmania, and southern New South Wales. Within this area, occurrences of the species are further limited by rainfall and temperature, and are often separated from one another by considerable distances.

Climatic Conditions.

In view of the fact that black wattle thrives so well in the summer rainfall areas of South Africa, it is surprising that its natural occurrence in Australia is confined to areas in which the bulk of the rainfall occurs during the winter. Within these areas, it is to be found on sites with annual precipitation ranging from as low as 20 to as high as 60 inches, but most of the recognized bark-producing areas have a rainfall between 30 and 40 inches.

The altitudinal range of the species is from sea-level to about 2,900 feet, and towards the upper limits of this range and the southern limit of its latitudinal range in Tasmania, it is subject to severe frosts every winter and, not infrequently, to falls of snow. Because of the relatively high latitudes in which it occurs, however, it is seldom exposed to high day temperatures, and even at the northern limit of its range, maxima seldom exceed 90°F. in summer.

It will be apparent, therefore, that areas in Natal and the South-eastern Transvaal which contain the bulk of the black wattle grown in the Union differ considerably in latitude, season of rainfall, and, to some extent, amount of rainfall from those in Australia. The South African industry is mainly concentrated between latitudes 26° and 31°S. or, on the average, eight degrees further north than the main concentration of natural wattle in Australia. This difference is partly compensated in terms of temperature

by the fact that wattle is grown at altitudes about 3,000 feet higher in South Africa than in Australia. When mean daily maximum and minimum temperatures in the two countries are compared, however, it is obvious that considerable differences exist, particularly in regard to winter and spring, even when allowance is made for altitude. Table I illustrates this point.

TABLE I

Comparison of mean daily maximum and minimum temperatures at moderate and high altitudes in wattle areas in Australia and South Africa

Mean daily maximum temperature (°F.)

Station	Altitude	Jan.	Feb.	Mar.	April	May	June	July	Aug.	Sep.	Oct.	Nov.	Dec.
Bodalla	approx. 100 ft.	78·6	74·6	73·5	71·6	64·2	59·5	59·1	64·0	65·8	69·6	71·3	71·9
Mistley	3200 ft	76·1	76·3	75·7	72·1	68·4	60·2	64·0	68·0	71·6	73·4	74·1	76·3
S.A. figures higher by		–2·5	1·7	2·2	0·5	4·2	0·7	4·9	4·0	5·8	3·8	2·8	4·4
Ballarat	approx. 1200 ft.	75·7	76·9	71·6	63·0	56·3	50·4	49·8	52·5	57·1	62·4	67·4	72·5
Piet Retief ..	4100 ft.	77·9	77·7	75·9	73·9	70·5	66·6	66·4	70·2	73·0	75·7	75·9	77·7
S A. figures higher by		2·2	0·8	4·3	10·9	14·2	16·2	16·6	17·7	15·9	13·3	8·5	5·2

Mean daily minimum temperatures (°F.)

Bodalla	approx. 100 ft.	58·8	59·7	58·4	51·2	42·1	35·6	34·3	37·3	41·9	46·3	45·6	52·9
Mistley	3200 ft.	56·8	57·4	56·1	51·8	46·6	41·9	41·9	44·8	48·0	51·1	52·9	55·6
S.A. figures higher by		–2·0	–2·3	–2·3	0·6	4·5	6·3	7·6	7·5	6·1	4·8	7·3	2·7
Ballarat	approx. 1200 ft.	50·5	52·9	50·1	45·8	42·6	39·5	38·4	39·4	41·2	43·6	46·0	49·3
Piet Retief ..	4100 ft.	58·8	58·5	56·5	51·1	45·0	39·2	38·8	43·0	47·8	53·2	55·6	57·6
S.A. figures higher by		8·3	5·6	6·4	5·3	2·4	–0·3	0·4	3·6	6·6	9·6	9·6	8·3

It is interesting to note that at the higher elevations, maximum day temperatures in winter and spring are much higher in South Africa than in Australia, whereas at lower altitudes, the differences are relatively small. On the other hand, the differences between South African and Australian minimum day temperatures in winter and spring are much greater at low than at high elevations. Hence, at the higher altitudes, the average difference between daily winter and spring maxima and minima in Australia is 14°F. and in South Africa 26°F., or nearly twice as great, whereas at the lower altitudes, the respective differences are 24°F. and 22°F., or virtually the same. It is obvious that this large diurnal fluctuation in temperature is one of the main reasons why black wattle tends to frost at higher elevations in South Africa, and the fact that similar large differences between daily maxima and minima are not found at high altitudes in Australia may reduce the chances of seed collected from such areas producing frost hardy offspring under South African conditions.

Soil Types.

Most of the soils on which black wattle occurs in Australia are derived from similar parent materials to those found in the wattle-growing areas of South Africa. Thus, soils derived from sandstones, shales, and granites are common in black wattle areas in New South Wales and Victoria, and wattle is to be found on dolerite-derived soils in Tasmania. Even the age of many of the parent systems in Australia is similar to those in South Africa, and black wattle in New South Wales is growing on soils derived from rocks equivalent in age to those of the Table Mountain, the Dwyka, and the Ecca Series. In the western highlands of Victoria, black wattle occurs on soils derived from granites and sandstones of about the same age as the Table Mountain Sandstone in South Africa, but elsewhere in the State, and particularly along the coast, wattle grows on soils derived from deposits of much more recent origin. These, in common with the soils of south-

eastern South Australia, are of Cretaceous or Tertiary origin and comparable with the coastal sands between Alexandria and Bredasdorp in South Africa, on which wattle has not been planted to any extent.

Nature of Occurrence.

Black Wattle occurs as an understory species in eucalypt forests in Australia, and because its natural range covers sites varying considerably both in altitude and rainfall, it is found in association with a variety of eucalypt species (Table II).

TABLE II

Altitudinal distribution of eucalypts associated with black wattle in various regions

Region	State	Coastal	Inland	
		Low altitude	Low altitude	High altitude
Western	South-eastern South Australia and Western Victoria	*E. ovata*	*E. camaldulensis* *E. huberiana* *E. melliodora*	*E. baxteri* *E. dives* *E. obliqua*
Central	Victoria	*E. globulus* var. *st. johnii* *E. goniocalyx*	*E. camaldulensis* *E. melliodora*	*E. baxteri* *E. dives* *E. obliqua*
S. Eastern	Eastern Victoria and Southern New South Wales	*E. bosistoana* *E. globulus* var. *st. johnii* *E. goniocalyx* *E. sieberiana*	*E. baueriana* *E. radiata* *E. scabra* *E. sideroxylon*	*E. robertsonii* *E. viminalis*
N. Eastern	Southern New South Wales	*E. maculata* *E. saligna*	*E. lindleyana* *E. smithii*	*E. rubida*
Southern	Tasmania	*E. sieberiana* *E. viminalis*	*E. salicifolia* (syn. *E. amygdalina*)	*E. obliqua*

The tree seldom reaches any appreciable size, partly because of the suppressive effect of the eucalypt overwood and partly because fires, which sweep through the eucalypt forests at fairly frequent intervals, kill off the wattle before it attains any great age. It acts as a pioneer species following fire or any other type of land clearing, and forms dense thickets along road edges, on abandoned farmlands, and in the bush itself after a fire has destroyed the ground vegetation and smaller trees.

In the forest and on drier sites in the open, the dense patches of seedling regeneration soon become thinned out by mutual competition and, if they escape destruction by fire, eventually form a scattered type of stand with individuals or small groups twenty or thirty yards apart. Occasionally, where site conditions are favourable and where there is no competing overwood, small areas will be found with a comparatively dense stocking of the order of three or four hundred trees to the acre, but such cases are extremely rare.

In Tasmania and in the drier and colder areas on the mainland, the tree is usually forked and heavily branched and seldom more than 25 feet high. In areas of average to good rainfall where soils are not particularly deep or fertile, a height of 40 to 45 feet is normal and trees often have fairly well-formed stems, but on the deeper soils, black wattle trees reach a height of 50 to 60 feet, or even more where they are not overtopped by eucalypts.

The principal areas in which black wattle was worked for bark in the past were in the vicinity of Mount Gambier in South Australia, the Victoria Valley near Hall's Gap

in the Grampians of Western Victoria, the coastal forests between Bairnsdale and Genoa in eastern Victoria, and the coastal forests of New South Wales between Nowra and Eden.

No black wattle of undoubted local origin could be found anywhere in the vicinity of Myrtleford or Bright in the Ovens Valley in north-eastern Victoria, although the vegetation map of Victoria compiled by the Forests Commission and at least two reference works on the forest flora of Victoria report its occurrence there. After gold-dredging in the Ovens Valley was discontinued some 30 years ago, black wattle seed was sown on the old dredge tailings in an attempt to secure re-vegetation of the river banks, and it is possible that the few survivors of these plantings have been assumed to be indigenous. Local forest officers, however, have undertaken to continue the search for naturally occurring black wattle in this district, because it is felt that an outlying occurrence such as this would be valuable as a seed source.

To-day, as a result of the recent drop in bark prices, black wattle stripping holds out very little attraction to the average Australian labourer, who can obtain a better livelihood in other types of forestry work, but some recent immigrants have taken to bark stripping and are apparently able to make a living from it.

Insect Pests and Diseases.

Apart from the high cost of labour, the one factor which has prevented the development of a wattle-growing industry in Australia is the large numbers of different species of insects which attack black wattle there. Attempts have been made at various times, to establish plantations in South Australia, Victoria, and New South Wales, but in all cases these trial plantings have been abandoned because of the damage done by insect pests.

Taking into consideration only the more important pests, there are nineteen species of beetles and seven species of Lepidoptera, as well as termites, gall-flies, ants, Membracids, Psyllids, and scale insects, which attack wattles. These pests include defoliators, stem-borers, root-feeders, seed-eaters, gall-makers, and sucking insects. In consequence, it is virtually impossible to find a black wattle tree in its native habitat which does not show evidence of insect attack in some form or another, and some trees are so damaged as to appear literally more dead than alive.

By contrast, black wattle does not seem to be particularly subject to disease in Australia, and apart from occasional signs of chlorosis and leaf-shedding, which may have been due to insect attack, no obvious disease symptoms were observed. Gum-exudations were noticed occasionally on the stem or branches of trees, but these seemed to be associated with damage done by boring insects, and no case of gummosis resembling that so commonly seen in South Africa was encountered. If the so-called physiological gummosis of black wattle in South Africa is indeed caused by an excessively rapid rate of growth of the tree, its absence in Australian black wattle is not surprising, since the normal growth rate of the species under natural conditions is comparatively slow.

Seed Collections for Breeding Work at the Wattle Research Institute.

Black wattle seed for use in breeding work was collected from twenty-four different localities covering, as far as possible, the altitudinal and latitudinal range of the species in the four States in which it occurs.

These localities are listed below in ascending order of altitude for each degree of latitude from north to south.

Between lat. 35° *and* 36°S.

(1) Nelligen, N.S.W. About 15 feet above sea-level. (N.5).
(2) Nelligen, N.S.W. About 50 feet above sea-level. (N.6).
(3) Milton, N.S.W. About 50 feet above sea-level. (N.9).
(4) Lake George, N.S.W. About 2,000 feet above sea-level. (N.1).
(5) Doughboy, N.S.W. About 2,500 feet above sea-level. (N.3).

Between lat. 36° *and* 37° *S.*

(6) Central Tilba, N.S.W. About 50 feet above sea-level. (N.7).
(7) Towamba, N.S.W. About 300 feet above sea-level. (N.8).
(8) Ovens Valley, Victoria. About 1,700 feet above sea-level (V.12).
(These trees were raised artificially from seed of unknown provenance, but have survived very cold conditions, so it was thought worth while collecting seed from them).
(9) Cooma, N.S.W. About 2,900 feet above sea-level. (N.4).

Between lat. 37° *and* 38° *S.*
Eastern end of range.

(10) Lake Tyers, Victoria. About 25 feet above sea-level. (V.2).
(11) Mt. Nowa Nowa, Victoria. About 1,100 feet above sea-level. (V.3 and V.4).
(12) Goongerrah Creek, Victoria. About 1,500 feet above sea-level. (V.1).
(13) Mt. Taylor, Victoria. About 1,750 feet above sea-level. (V.6).
(14) Tonghio Gap, Victoria. About 2,000 feet above sea-level. (V.5).

Central portion of range.

(15) Lal Lal, Victoria. About 1,250 feet above sea-level. (V.13).

Western end of range.

(16) Gorae West, Victoria. About 50 feet above sea-level. (V.11).
(This locality is a little south of latitude 38°S. and was the most southerly collection made in continental Australia).
(17) Nangwarry, S. Australia. About 200 feet above sea-level. (S.1).
(18) Penola, S. Australia. About 200 feet above sea-level. (S.2).
(19) Roses Gap, Victoria. About 1,000 feet above sea-level. (V.7).
(20) Victoria Valley, Victoria. About 1,000 feet above sea-level. (V.9 and V.10).
(21) Wartook, Victoria. About 1,800 feet above sea-level. (V.8).

Between lat. 41½° *and* 42½° *S.*

(22) Moulting Bay Lagoon, Tasmania. About 10 feet above sea-level. (T.4).
(23) Swansea, Tasmania. About 50 feet above sea-level. (T.1).
(24) Between Cranbrook and Apslawn, Tasmania. About 350 feet above sea-level. (T.3).
(25) Swansea-Lake Leake road, Tasmania. About 700 feet above sea-level. (T.2).

Bark samples were collected from trees at localities numbered (6) and (9) and these, together with samples from two other trees, Nos. 4 and 14, the identity of which was in doubt, were analysed at the Institute. The results of these analyses were as follows:

	(6)	(9)	No. 4	No. 14
Tans %	49·0	37·6	31·5	28·2
Non-tans %	9·0	13·1	11·0	12·1
Insolubles %	1·3	1·1	0·6	1·6
Fibre %	29·9	38·5	46·9	47·0
Water %	10·8	9·7	10·0	11·1
	100·0	100·0	100·0	100·0
I.Q.*	1·983	1·345	0·919	0·891
Red	5·1	6·8	11·4	8·8
Yellow	6·0	7·8	14·8	10·7

* I.Q. (Index of Quality) $= \frac{\text{Tans}+\text{Non-tans}+\text{Insolubles}}{\text{Fibre}}$

Leaf specimens taken from tree No. 4 were identified by Miss Tindale as possibly *Acacia parramattensis* and those from tree No. 14 as black wattle. The latter was a young tree growing near the foot of the Brown Mountain in New South Wales, and specimens were taken from it because it resembled black wattle, but did not seem quite typical of that species. Its low tannin content and high colours suggest that it may have been a hybrid.

Seed was also collected from *Acacia irrorata* growing on a cold, exposed site near Thulimbah on the Darling Downs in Queensland, and from *Acacia silvestris*, a species recently described by Tindale, in its type locality at Bodalla in New South Wales.

The former species resembles black wattle in some respects, and this similarity has led to the two species being confused. It is now definitely established that black wattle does not occur naturally in northern New South Wales or Queensland and that all reported occurrences of the species north of Sydney are either introduced trees or *Acacia irrorata*. Bark samples of the latter species from Queensland were analysed at the Institute and found to have a low tannin content (32·8%) and very high colours. It is unlikely, therefore, that *Acacia irrorata* will prove of much value for breeding work in South Africa.

Acacia silvestris is a large tree up to 100 feet in height, usually with a fairly well-developed, straight stem. It is not highly regarded as a source of tan-bark in Victoria, according to forest officers in the localities in which it occurs, and did not appear to be recognized as a tan-bark species by the only forester who could be consulted during the New South Wales tour. This is rather surprising, because bark samples from a tree near Bruthen in Victoria, identification of which as *A. silvestris* was confirmed by Miss Tindale, had a tannin content of 42·4%, good colours, and an index of quality of 2·235. It would seem, therefore, that this species might be worth a trial in South Africa as an alternative to black wattle, rather than as a possible parent of hybrids with that species. Although it appears to occur mainly at low altitudes near the coast, it has been collected at about 2,000 feet near Wulgulmerang and may possess some degree of hardiness to cold.

Acknowledgements.

Many useful contacts with foresters in different areas were made in the course of the tour. These contacts will facilitate further seed collections in any area which initial trials indicate as likely to provide material of value.

The writer acknowledges with gratitude the very considerable assistance given him by the Director of Parks and Gardens at Canberra and by State forest authorities in the course of this tour, firstly in supplying official transport, secondly in providing forest officers as guides, and thirdly in arranging for the collection of seed from the selected trees when it ripened and dispatching it to South Africa. Miss M. Tindale, of the National Herbarium, gave invaluable assistance in identifying herbarium material and suggesting likely areas for exploration.

NOTES ON WATTLE INSECTS OBSERVED DURING THE PERIOD 1957-1958

By L. L. J. OSSOWSKI

An account is given of wattle insects observed during 1957–1958 and of the damage done. Two insects, the thorn bagworm and wireworms, not previously recorded as potential wattle pests are mentioned.

The number of some insects increased in the year under review, notably wattle noctuids, some wattle chafers, and froghopper. A decrease was noted in the population of some lasiocampids and of the wattle webworm.

I. ORDER: LEPIDOPTERA

Family: *Psychidae*

1. *Wattle bagworm,* Kotochalia junodi (*Heyl.*).

The area infested with bagworms during the past season amounted to nearly 100,000 acres, the main centres again being in the Midlands of Natal, particularly in the Kranskop, Umvoti, New Hanover, and Greytown Magisterial Districts, with over 30,000 acres infested and more than 4,000 acres defoliated. During the coming season, defoliation over larger areas is expected, especially in the New Hanover, Greytown, and Kranskop Districts.

In the southern area, the infestation reached the eruptive stage during the past season in nearly all plantations around Lusikisiki and south of Bizana and Flagstaff. North of the two last-named localities, the eruptive stage will probably be reached during the coming season and over 1,000 acres may become defoliated. In the Paddock–Harding area, several hundred acres were partially defoliated; the infestation may enter the eruptive stage in the coming season and over 1,500 acres may become defoliated.

In plantations around Ixopo and Richmond, the infestation entered the second year of the premonitory stage, and during the coming year, defoliation over some 2,000 acres is to be expected. In the Lions River–Howick–Karkloof area, the eruptive stage has been reached in nearly all infested plantations; the crisis may take place during 1958–1959, but partial defoliation of approximately 2,000 acres may still be expected. In Zululand, the infestation is building up and during the coming season, may enter the first year of the premonitory stage. Up to 1,500 acres of plantations, mainly growing on marginal land, will probably be defoliated.

In plantations in the northern area, the infestation is steadily building up. Around Enyati, Hlobane, and north of Glückstadt, the first year of the premonitory stage was reached in 1957–1958. In the coming season, the second year of the premonitory stage may follow, but only in plantations around Enyati and Hlobane, with partial defoliation of up to 1,000 acres. North of Glückstadt, however, the eruptive stage may take place during 1958–1959, with complete defoliation of some plantations. The bagworm population is increasing in plantations at Scheepersnek and also in some parts of the Kambula area. The first year of the premonitory stage may be reached this year around Scheepersnek and several hundred acres of wattles will probably become partially defoliated. In the Kambula district, the same will probably take place one year later.

A marked increase in the bagworm population has been recorded in the Transvaal and Swaziland areas. During the past season, the first year of the premonitory stage was reached in plantations north of Piet Retief, particularly in the Kemp area, and also around Goedgegun, Swaziland. The development of the infestation was somewhat more advanced in the lower-lying blocks west of Kemp and in plantations south-west of Hlatikulu, Swaziland, where in some parts, the eruptive stage was reached in 1957–1958. In these plantations, the crisis may take place during the coming year. Partial or complete defoliation is to be expected during the coming season over more than 3,500 acres in the Piet Retief district and in plantations in Swaziland.

Small centres of infestation, with a bagworm population on the increase, were noticed north-east of Piet Retief, particularly around Watersmeet, whence the infestation may spread during the following seasons.

Family: *Tineidae*

2. *Thorn Bagworm,* Melasina halicutis *Meyr.*

For the first time, this bagworm was reported to have damaged wattle plantations, notably some 50 acres of the Garfield Estate in Zululand. Little is known of its life cycle, but since newly-hatched thorn bagworms are to be found in October and February, it may be assumed that there are at least two generations per annum. For building their bags, these bagworms use nothing but the fine particles of the leaf or bark on which they feed. These particles are arranged in smooth, narrow collars, accurately joined together and increasing in diameter towards the mouth end, which form a bag shaped like a smooth greyish-brown thorn.

Family: *Lasiocampidae*

3. *Grey Wattle Lappet Moth,* Pachypasa truncata *Wlk.*

Over 400 acres of seven- to eight-year-old wattles were partially defoliated around Ermelo, and nearly 200 acres of four- to six-year-old trees were completely defoliated in the Greytown area.

Family: *Saturniidae*

4. *Wattle Emperor Moth,* Gynanisa maia (*Klug*).

Larvae were abundant in two-year-old plantations at Bloemendal, but no appreciable damage was done. A hymenopterous parasite, *Mesocomys* sp. nr. *vuiletti* Crawf., was found to attack eggs of this pest.

5. *Willow Tree Emperor Moth,* Gonimbrasia tyrrhea *Cram.*

Approximately 40 acres of young wattles were completely defoliated by this saturnid in Tsomo, Transkei.

Family: *Noctuidae*

6. *Wattle Noctuid,* Achaea lienardi *Boisd.*

This insect was widespread throughout the Midlands of Natal and Pondoland, where the main centres of infestation were in the Albert Falls, Hill Crest, and Lusikisiki districts. In all, over 2,000 acres were infested and partially defoliated. Some 50 acres in Bloemendal, which showed a heavy infestation in 1951, were again heavily infested during 1957–1958 and partially defoliated.

Family: *Tortricidae*

7. *Wattle Webworm,* Polychrosis incultana *Wlk.*

Outbreaks of this pest coincided with an attack of froghopper in the Kambula and Albert Falls areas, where over 150 acres were damaged.

II. ORDER: COLEOPTERA

Family: *Melolonthidae*

8. *Large Wattle Chafer,* Hypopholis sommeri *Burm.*

The large wattle chafer damaged over 2,000 acres of wattle, mainly one to three years old. The main centres of infestation were in the Midlands of Natal, especially in in Riet Vlei area, where on one farm alone, more than 400 acres were damaged. Larvae destroyed seedlings on 60 acres in Zululand and some 50 acres near Seven Oaks.

9. *Small Wattle Chafer,* Monochelus calcaratus *Burm.*

This beetle did less damage during 1957–1958 than in the previous season. In all, some 150 acres were reported to be damaged west of Ixopo.

10. *Mashonaland Chafer,* Eulepida mashona *Arrow.*

The population of this chafer appears to be again on the increase in the Chipinga-Melsetter district, but no damage done by larvae was reported.

Family: *Chrysomelidae*

11. *Iridescent Wattle Chrysomelid,* Colasposoma fulgidum *Lef.*

The occurrence of this pest was reported from a farm in the Dalton area, where 5 acres of young wattles were attacked and partially defoliated.

Family: *Elateridae*

12. *Wireworms,* Agriotes *spp.*

A report was received from Southern Rhodesia of damage done by wireworms which destroyed seedlings over an estimated area of 100 acres. The density of the larval population was approximately 250,000 per acre. Wireworms have not hitherto been reported as pests of wattle.

Family: *Cerambycidae*

13. *Red-banded Longhorn Beetle,* Pycnopsis brachyptera *Thoms.*

Damage done by this longhorn beetle was evident in plantations around Ahrens and Table Mountain, Natal. Particularly severe damage was observed in the Glückstadt district.

III. ORDER: ORTHOPTERA

Family: *Acrididae*

14. *Elegant or Soldier Locust,* Locusta elegans (*Thunb.*).

The soldier locust was reported to have damaged nearly 30 acres of one-year-old wattle in the Seven Oaks area. Mainly the thinner top parts of trees were attacked; in consequence, tops were broken by wind and crowns deformed.

IV. ORDER: HEMIPTERA

Families: *Jassidae* (*Cicadellidae*) and *Capsidae* (*Miridae*)

15. *Large Green Jassid,* Bythoscopus cedaranus *Naudé,* and

16. *Brown Capsid,* Lygidolon laevigatum *Reut.*

These sucking insects were very abundant in the drier parts of the wattle belt, where over 8,000 acres were affected. Damage was particularly serious in Zululand, with 1,500 acres infested, around Ixopo, where over 1,000 acres were damaged, and in the Vryheid and Piet Retief areas, where damage occurred over nearly 2,000 acres. In some plantations in the last-named areas, the damage was not confined as is usual to smaller trees, but wattle up to 20 feet high showed current froghopper injuries. Attacks of froghopper nearly always coincided with those of the webworm and of a species of *Opogona* (Lepidoptera).

It was reported from Southern Rhodesia that froghopper was widespread with varying intensity in the Vumba, Melsetter, and Chipinga areas.

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SPRAYING EXPERIMENTS WITH INSECTICIDES AGAINST WATTLE BAGWORM, *KOTOCHALIA JUNODI* (HEYL.). II

By L. L. J. OSSOWSKI

Single tree plots were treated from the ground with three different insecticides, toxaphene, endrin, and a similar chlorinated hydrocarbon WL 1650. The insecticide was dissolved in light diesel oil, toxaphene at the rate of 0·75 lb. per gallon of solution, and the two others at 0·67 ounce per gallon. The rate of application was two gallons per acre. One experiment was carried out when the bagworm larvae were in their earlier instars and another when the insects were older. Mortality was assessed eleven days after spraying in the first and after fourteen days in the second experiment. The rate of "fall-off" of dead and moribund larvae was also determined.

In both experiments, no difference in the final percentage "fall-off" between the treated plots was found, though in the first experiment, the initial rate was highest in those treated with endrin. There was no significant difference in overall toxicity between the insecticides applied against larvae in their earlier instars. Endrin, however, was significantly superior to the others when used against older larvae.

In the first of this series of experiments (Ossowski, 1956), four insecticides were tested against wattle bagworm by treating wattles with solutions in oil applied at the rate of three gallons per acre. In order to compare the efficacy of two of these insecticides, toxaphene and endrin, applied to very young plantations at the rate of two gallons per acre, two pilot experiments were carried out during the 1957–1958 season. In addition to these two insecticides, another chlorinated hydrocarbon, WL 1650, was tested.

Plot Layout and Description.

In both pilot experiments, four treatments, including control, in eight-fold, replicated, randomized, single-tree plots were applied. The trees, under one year old, were from 4 to 6 feet high and could, therefore, be sprayed very easily from the ground. The distance between the rows used was approximately 15 feet, and that between sample trees in the rows 30 feet.

Insecticides and Methods of Application.

The first experiment was started on 7th November, 1957, when 25 per cent. of larvae were in their first instar, 74 per cent. in their second, and 1 per cent. in their third. In the second experiment, started on 17th December, 24 per cent. were in their second instar, 52 per cent. in the third, and 24 per cent. in the fourth.

Each insecticide was dissolved in light diesel oil, toxaphene at the rate of 0·75 lb. per gallon of solution, and the other two at the rate of 0·67 oz. per gallon. The insecticide was applied at the nominal rate of two gallons per acre by means of a pneumatic "Warley" sprayer equipped with a "Watson" nozzle No. 3.5. The pressure was 80 lb. per square inch and each tree was sprayed for four seconds. In the first experiment, a total of 0·45 inch of rain fell between the time of spraying and sampling, which was undertaken 11 days after treatment. In the second, a total of 2·19 inches fell between spraying and sampling 14 days later. The temperature during the earlier application was 61°F., with a relative humidity of 94 per cent., and during the second 72°F., relative humidity 89 per cent. The sky was clear and there was no wind during the spraying of each experiment.

Methods of Sampling.

In order to determine the "fall-off" of bagworms in the interval between spraying and sampling, all bagworms were counted on the sample trees shortly before the commencement of operations and at various intervals afterwards, the last count being taken on the day the insects were collected for the mortality assessment, which was done by the method already described (Ossowski, 1954).

Results.

In the first experiment, three trees out of eight sprayed with WL 1650 and two in each of the other treatments had a complete kill. There was, however, no significant difference in the mean percentage mortality (Table I) in the three treatments.

TABLE I

Mortality of bagworms in early instars 11 *days after treatment*

Insecticide	Total mortality %		Mean corrected kill %
	Range over 8 replicates	Mean	
Endrin	83·2—100·0	93·5	91·3
Toxaphene ..	92·3—100·0	94·3	92·3
WL 1650.. ..	86·8—100·0	94·5	92·6
Unsprayed control	11·8— 42·3	25·6	—

Standard error	2·95
Significant difference (P=0·05)	8·67
Significant difference (P=0·01)	11·81

There was no difference in the final percentage "fall-off" of bagworms between the treated plots, but it was much higher than in the untreated (Table II). Those treated with endrin, however, showed a higher initial proportion, which suggests a more rapid toxic action against early instars by this insecticide.

TABLE II

Mean percentage "fall-off" (additive) of younger bagworms per tree at intervals after spraying

Treatment	24 hours	4 days	7 days	11 days	Total
Endrin ..	9·9	8·2	9·5	4·7	32·3
Toxaphene	6·6	8·4	8·4	6·3	29·7
WL 1650 ..	3·6	11·8	7·2	10·0	32·6
Unsprayed control	1·1	2·6	3·8	2·9	10·4

In the second experiment, four trees sprayed with endrin, three with toxaphene, and one with WL 1650 had a complete kill. The mean corrected kill (Table III) was significantly higher (P=0·05) in trees sprayed with endrin than in the other treatments, which did not differ significantly from each other.

TABLE III

Mortality of bagworms in later instars 14 *days after treatment*

Insecticide	Total mortality %		Mean corrected kill %
	Range over 8 replicates	Mean	
Endrin ..	94·3—100·0	97·2	96·5
Toxaphene	71·0—100·0	86·5	82·9
WL 1650 ..	71·2—100·0	85·6	81·8
Unsprayed control ..	8·3— 35·7	21·0	—

Standard error	3·76
Significant difference (P=0·05)	11·06
Significant difference (P=0·01)	15·05

There was also no significant difference in the final percentage "fall-off" of bagworms between the treated plots, but it was higher than in the untreated (Table IV).

TABLE IV

Mean percentage "fall-off" (additive) of older bagworms per tree at intervals after spraying

Treatment	24 hours	4 days	7 days	11 days	14 days	Total
Endrin	2·2	2·2	5·0	5·8	5·8	21·0
Toxaphene	3·4	3·6	4·0	5·9	4·6	21·5
WL 1650..	3·1	4·2	6·2	4·9	3·5	21·9
Unsprayed control ..	0	1·2	3·5	1·2	0·4	6·3

These experiments indicate that there is no significant difference in ultimate efficacy between toxaphene, endrin, and WL 1650 when bagworm larvae are in their early instars, but endrin has a somewhat more rapid initial toxic effect. Against older larvae, endrin is the most effective.

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